

# AIRS/AMSU/HSB Version 6 Retrieval Flow

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# 1 INTRODUCTION TO V6 RETRIEVAL FLOW

All quantities marked **best** (associated quality factor = 0) and almost all quantities marked **good** (associated quality factor = 1) have passed through the entire retrieval system. It may be helpful to some users to understand the processing paths by which termination of the V6 retrieval process can occur. The steps are single-path sequential for V6, but early termination occurs when something fails along the way. There are four possibilities, listed below.

- Retrievals falling into cases 3 and 4 are considered to be successful MW/IR retrievals. Products should be used or avoided as indicated by their individual quality flags. The user is encouraged to read **V6\_L2\_Quality\_Control\_and\_Error\_Estimation.pdf**, which describes the individual quality flags.
  - Retrievals falling into case 1 should not be used for any purpose.
  - Retrievals falling into case 2 reliably contain only microwave products.
1. Data are incomplete due to instrument, sensor or downlink problems. All values will be fill values (-9999), with quality factor 2. During the first ten years of operation, beginning September 2002, this has happened in slightly less than 1% of Version 5 retrievals and we do not expect the frequency of occurrence to be different in Version 6.
  2. The retrieval initiates, but some step does not succeed due to calculation problems (non-invertible matrices corresponding to unobservable variables, etc.) All data are marked quality 2, but depending on the point in the retrieval process wherein the failure occurred, some data fields may be populated and others may have fill values. We estimate this occurs in 0.2% of retrievals.
  3. All steps succeed through final temperature retrieval, but failure occurs in retrieval of CO or CH<sub>4</sub>. CO or CH<sub>4</sub> are marked bad (associated quality flags set to 2), and other products are marked as in case 4. The frequency of occurrence is yet known for Version 6 but is expected to be far less than for Version 5.
  4. All steps execute. Quality control is applied as described in the document, **V6\_L2\_Quality\_Control\_and\_Error\_Estimation.pdf**. We estimate 99% of retrievals are in this case.

A step-by-step comparison of V5 and V6 retrieval flow follows.

## 2 COMPARISON OF V5 AND V6 RETRIEVAL FLOWS

Version 5	Version 6	Version 6 AIRS-Only
<b>MW-Only Retrieval</b> $X^{\text{CLIM}}, R_{\text{MW}} \Rightarrow X^{\text{MW}}$ $(\varepsilon_{\text{MW}}, q_{\text{liq}}, C_s)$	<b>MW-Only Retrieval</b> $X^{\text{CLIM}}, R_{\text{MW}} \Rightarrow X^{\text{MW}}$ $(\varepsilon_{\text{MW}}, q_{\text{liq}}, C_s)$	
<b>Cloudy Regression</b> $R_{\text{MW}}, R_{\text{IR}} \Rightarrow X^{\text{CR}}$	<b>Neural Network</b> $R_{\text{MW}}, R_{\text{IR}} \Rightarrow X^{\text{NN}}$	<b>Neural Network</b> $R_{\text{IR}} \Rightarrow X^{\text{NN}}$
<b>AMSU Retrieval</b> $R_{\text{MW}}, X^{\text{CR}} \Rightarrow X^0$ (update T, T <sub>s</sub> , $\varepsilon_{\text{MW}}$ )	<b>AMSU Retrieval</b> $R_{\text{MW}}, X^{\text{NN}} \Rightarrow X^0$ (update T, $\varepsilon_{\text{MW}}$ )	set $X^0 = X^{\text{NN}}$
<b>Cloud Parm Ret 1</b> $\alpha^0, P_c^0$	<b>Cloud Parm Ret 1</b> $\alpha^0, P_c^0$	<b>Cloud Parm Ret 1</b> $\alpha^0, P_c^0$
<b>1<sup>st</sup> Cloud Clearing</b> $R_{\text{IR}}, X^0 \rightarrow \hat{R}_{\text{IR}}^0$	<b>1<sup>st</sup> Cloud Clearing</b> $R_{\text{IR}}, X^0 \rightarrow \hat{R}_{\text{IR}}^0$	<b>1<sup>st</sup> Cloud Clearing</b> $R_{\text{IR}}, X^0 \rightarrow \hat{R}_{\text{IR}}^0$
<b>Regression</b> $\hat{R}_{\text{IR}}^0 \rightarrow X^{\text{REG}}$ (T, T <sub>s</sub> , q, $\varepsilon_{\text{IR}}$ )		
<b>AMSU Retrieval</b> $R_{\text{MW}}, X^{\text{REG}} \Rightarrow X^1$ (update T, T <sub>s</sub> , $\varepsilon_{\text{MW}}$ )	<b>AMSU Retrieval</b> $R_{\text{MW}}, X^0 \Rightarrow X^1$ (update T, $\varepsilon_{\text{MW}}$ )	set $X^1 = X^{\text{NN}}$
<b>Cloud Parm Ret 2</b> $\alpha^1, P_c^1$	<b>Cloud Parm Ret 2</b> $\alpha^1, P_c^1$	<b>Cloud Parm Ret 2</b> $\alpha^1, P_c^1$
(continued next page)	(continued next page)	(continued next page)

Version 5	Version 6	Version 6 AIRS-Only
<b>2<sup>nd</sup> Cloud Clearing</b> $R_{IR}, X^1 \rightarrow \hat{R}_{IR}^1$	<b>2<sup>nd</sup> Cloud Clearing</b> $R_{IR}, X^1 \rightarrow \hat{R}_{IR}^1$	<b>2<sup>nd</sup> Cloud Clearing</b> $R_{IR}, X^{REG} \rightarrow \hat{R}_{IR}^1$
<b>Physical Retrieval 1</b> $X^1, \hat{R}_{IR}^1 \Rightarrow X^{PHYS}$ ( $T_s, \epsilon_{IR}, \rho_{IR}, T, q, O_3$ )	<b>Physical Retrieval 1</b> $X^1, \hat{R}_{IR}^1 \Rightarrow X^{PHYS}$ ( $T_s, \epsilon_{IR}, \rho_{IR}, T, q, O_3$ )	<b>Physical Retrieval 1</b> $X^1, \hat{R}_{IR}^1 \Rightarrow X^{PHYS}$ ( $T_s, \epsilon_{IR}, \rho_{IR}, T, q, O_3$ )
<b>AMSU Retrieval</b> $R_{MW}, X^{PHYS} \Rightarrow X^{test}$ ( for quality control)	<b>AMSU Retrieval</b> $R_{MW}, X^{PHYS} \Rightarrow X^{test}$ ( for quality control)	
<b>Cloud Parm Ret 3</b> $\alpha^2, P_c^2$	<b>Cloud Parm Ret 3</b> $\alpha^2, P_c^2$	<b>Cloud Parm Ret 3</b> $\alpha^2, P_c^2$
<b>3<sup>rd</sup> Cloud Clearing</b> $R_{IR}, X^{PHYS} \rightarrow \hat{R}_{IR}^2$	<b>3<sup>rd</sup> Cloud Clearing</b> $R_{IR}, X^{PHYS} \rightarrow \hat{R}_{IR}^2$	<b>3<sup>rd</sup> Cloud Clearing</b> $R_{IR}, X^{PHYS} \rightarrow \hat{R}_{IR}^2$
<b>Physical Retrieval 2</b> $X^1, X^{PHYS}, \hat{R}_{IR}^2 \Rightarrow X^{final}$ ( $T_s, \epsilon_{IR}, \rho_{IR}, T, CO, CH_4$ )	<b>Physical Retrieval 2</b> $X^1, X^{PHYS}, \hat{R}_{IR}^2 \Rightarrow X^{final}$ ( $T_s, \epsilon_{IR}, \rho_{IR}, T, CO, CH_4$ )	<b>Physical Retrieval 2</b> $X^1, X^{PHYS}, \hat{R}_{IR}^2 \Rightarrow X^{final}$ ( $T_s, \epsilon_{IR}, \rho_{IR}, T, CO, CH_4$ )
<b>Choose Final State</b> $X^{OUT} = X^0 \text{ or } X^{final}$	<b>Choose Surface for Cloud/OLR Calculation</b> $S^{OLR} = X^0 \text{ or } X^{final}$	<b>Choose Surface for Cloud/OLR Calculation</b> $S^{OLR} = X^0 \text{ or } X^{final}$
	<b>Cloud Parm Ret 4</b> $\alpha^3$	<b>Cloud Parm Ret 4</b> $\alpha^3$
	<b>4<sup>th</sup> Cloud Clearing</b> $, X^{PHYS} \rightarrow$	<b>4<sup>th</sup> Cloud Clearing</b> $, X^{PHYS} \rightarrow$
$X^{OUT} \rightarrow OLR$	$X^{final}, S^{OLR} \rightarrow OLR$	$X^{final}, S^{OLR} \rightarrow OLR$
<b>Error Estimates <math>\delta X</math></b>	<b>Error Estimates <math>\delta X</math></b>	<b>Error Estimates <math>\delta X</math></b>
<b>Quality Control</b>	<b>Quality Control</b>	<b>Quality Control</b>

### 3 NOTATION

#### 3.1 Atmospheric States

$X^{CLIM}$  climatology atmospheric state, with the addition of the AVN surface pressure derived from the 3, 6 and 9 hour forecasts

- $X^{MW}$  atmospheric state derived by MW-Only Retrieval (product)
- $X^{CR}$  atmospheric state derived by Cloudy Regression
- $X^{NN}$  atmospheric state derived by Stochastic Cloud Clearing/Neural Network
- $X^{REG}$  atmospheric state derived by Regression
- $X^{PHY}$  atmospheric state derived by Physical Retrieval
- $X^n$   $n^{th}$  atmospheric state
- $X^{test}$  derived atmospheric state used only for quality control
- $X^{final}$  final atmospheric state derived by physical retrieval algorithm
- $S^{OLR}$  surface parameters used for clouds and OLR
- $X^{OUT}$  atmospheric state reported as product
- $\delta X$  error estimate for atmospheric state product

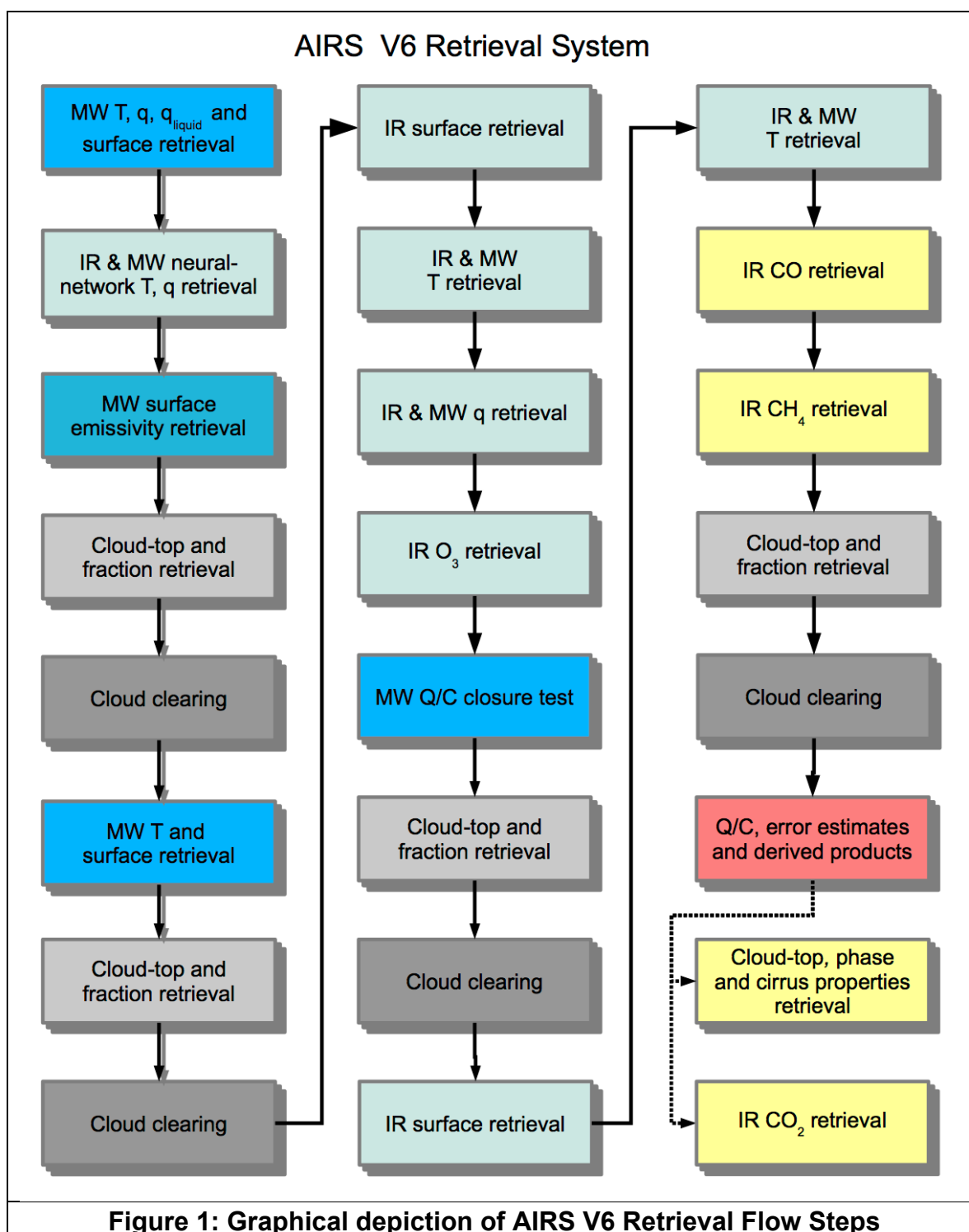
Note: The climatology atmospheric state is derived from ECMWF.

### **3.2 Operations**

- $X^a \Rightarrow X^b$  retrieval of atmospheric state “b” starting from state “a”
- $X^c \rightarrow$  derivation of parameter(s) from atmospheric state “c”

### 3.3 Physical Parameters

$R_{MW}$	observed MW radiances
$R_{IR}$	observed (cloudy) IR radiances
$\hat{R}_{IR}^c$	cloud cleared IR radiances derived from atmospheric state “c”
$\alpha^n$	cloud fraction, iteration “n”
$P_c^n$	cloud top pressure, iteration “n”
$q_{liq}$	liquid water content from MW-Only Retrieval
$C_s$	surface classification from MW-Only Retrieval
$\epsilon_{MW}$	surface emissivity from MW-Only Retrieval
$\epsilon_{IR}$	surface emissivity in infrared
$\rho_{IR}$	surface reflectivity in shortwave infrared
$T_s$	surface skin temperature
<b>OLR</b>	outgoing longwave radiation product
<b>T</b>	$T_{air}$ profile product
<b>q</b>	precipitable water vapor profile/burden product
<b>O<sub>3</sub></b>	ozone profile/burden product
<b>CO</b>	carbon monoxide profile/burden product
<b>CH<sub>4</sub></b>	methane profile/burden product
<b>(a, b, c)</b>	retrieve physical parameters a, b, c
<b>(update a, b, c)</b>	update previously retrieved parameters a, b, c



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